CLAIMS

1. A method for use with an implanted medical device having two conductive elements in contact with tissue of a subject, the method comprising:

providing a first impedance between the conductive elements when the subject is exposed to a source of radiofrequency (RF) energy; and

providing a second impedance between the conductive elements, at least two times greater than the first impedance, when the subject is not exposed to the RF energy.

2. A method according to claim 1, wherein providing the first impedance comprises providing a resistance.

3. A method according to claim 1, wherein providing the first impedance comprises providing a capacitance.

4. A method according to claim 1, wherein providing the first impedance comprises providing an impedance less than 2000 ohms.

5. A method according to claim 1, wherein providing the second impedance comprises providing an impedance at least 4 times greater than the first impedance.

6. A method according to claim 1, wherein providing the second impedance comprises providing an impedance of at least 3000 ohms.

7. A method according to claim 1, wherein providing the first impedance comprises providing an impedance at least 50% less than an impedance of the tissue.

8. A method according to claim 1, wherein the tissue includes heart tissue of the subject and the conductive elements are in contact with the heart tissue, and wherein providing the first impedance comprises providing the first impedance between the conductive elements in contact with the heart tissue.

9. A method according to claim 1,

wherein the tissue includes tissue of a structure of the subject and the conductive elements are in contact with the tissue of the structure, the structure selected from the list consisting of: a sphenopalatine ganglion (SPG) of the subject, an anterior ethmoidal nerve of the subject, a posterior ethmoidal nerve of the subject, a communicating branch between an anterior ethmoidal nerve and a retro-orbital branch of an SPG of the subject, a communicating branch between a posterior ethmoidal nerve and a retro-orbital branch of an SPG of the subject, a greater palatine nerve of the subject, a lesser palatine nerve of the

subject, a sphenopalatine nerve of the subject, a communicating branch between a maxillary nerve and an SPG of the subject, a nasopalatine nerve of the subject, a posterior nasal nerve of the subject, an infraorbital nerve of the subject, an otic ganglion of the subject, an afferent fiber going into the otic ganglion of the subject, an efferent fiber going out of the otic ganglion of the subject, a vidian nerve of the subject, a greater superficial petrosal nerve of the subject, a lesser deep petrosal nerve of the subject, a cranial nerve of the subject, a nerve to a bladder of the subject, a pudendal nerve of the subject, a nerve of an upper limb of the subject, and a nerve of a lower limb of the subject, and

wherein providing the first impedance comprises providing the first impedance between the conductive elements in contact with the tissue of the structure.

10. A method according to any one of claims 1-9, wherein the tissue includes tissue in a head of the subject and the conductive elements are in contact with the tissue in the head, and wherein providing the first impedance comprises providing the first impedance between the conductive elements in contact with the tissue in the head.

11. A method according to claim 10, wherein the tissue includes brain tissue of the subject and the conductive elements are in contact with the brain tissue, and wherein providing the first impedance comprises providing the first impedance between the conductive elements in contact with the brain tissue.

12. A method according to any one of claims 1-9, wherein providing the second impedance comprises providing an open circuit between the conductive elements.

13. A method according to claim 12, wherein providing the open circuit comprises providing the open circuit unless an override signal to provide a closed circuit is received.

14. A method according to claim 12, wherein providing the open circuit comprises receiving a signal from a remote site, and providing the open circuit responsive to the signal.

15. A method according to claim 14, wherein the signal includes an infrared signal, and wherein providing the open circuit comprises providing the open circuit responsive to the infrared signal.

16. A method according to claim 14, wherein the signal includes an RF signal, and wherein providing the open circuit comprises providing the open circuit responsive to the radiofrequency signal.

17. A method according to any one of claims 1-9,

wherein the source of RF energy includes a diagnostic imaging modality,

wherein providing the first impedance comprises providing the first impedance when the subject is exposed to the imaging modality, and

wherein providing the second impedance comprises providing the second impedance when the subject is not exposed to the imaging modality.

18. A method according to claim 17,

wherein the imaging modality includes magnetic resonance imaging (MRI),

wherein providing the first impedance comprises providing the first impedance when the subject is exposed to the MRI, and

wherein providing the second impedance comprises providing the second impedance when the subject is not exposed to the MRI.

19. A method according to claim 18,

wherein providing the first impedance comprising providing the first impedance when the tissue is exposed to RF energy with a frequency greater than a threshold value no greater than the lowest frequency of RF energy generated by an MRI device generating the RF energy, and

wherein providing the second impedance comprises providing the second impedance when the tissue is not exposed to RF energy with a frequency greater than the threshold value.

20. A method according to claim 19, wherein the threshold value is 5 MHz, and wherein providing the first impedance comprises providing the first impedance when the tissue is exposed to RF energy with a frequency greater than 5 MHz.

21. Apparatus for use with an implanted medical device having two conductive elements in contact with tissue of a subject, the apparatus comprising a shunt, electrically coupled between the conductive elements, the shunt adapted to be in a first state when the subject is exposed to a source of radiofrequency (RF) energy, and adapted to be in a second state when the subject is not exposed to the RF energy, the shunt being characterized such that in the first state the shunt has a first impedance, and in the second state the shunt has a second impedance at least two times greater than the first impedance.

22. Apparatus according to claim 21, wherein the conductive elements comprise electrodes.

23. Apparatus according to claim 21, wherein the first impedance is less than 2000 ohms, and wherein the shunt is adapted to have the first impedance when in the first state.

24. Apparatus according to claim 21, wherein the second impedance is at least 4 times greater than the first impedance, and wherein the shunt is adapted to have the second impedance when in the second state.

25. Apparatus according to claim 21, wherein the second impedance is at least 3000 ohms, and wherein the shunt is adapted to have the second impedance when in the second state.

26. Apparatus according to claim 21, wherein the first impedance is at least 50% less than an impedance of the tissue, and wherein the shunt is adapted to have the first impedance when in the first state.

27. Apparatus according to claim 21, wherein the tissue includes heart tissue of the subject and the conductive elements are in contact with the heart tissue, and wherein the shunt is adapted to be electrically coupled between the conductive elements in contact with the heart tissue.

28. Apparatus according to claim 21,

wherein the tissue includes tissue of a structure of the subject and the conductive elements are in contact with the tissue of the structure, the structure selected from the list consisting of: a sphenopalatine ganglion of the subject (SPG), an anterior ethmoidal nerve of the subject, a posterior ethmoidal nerve of the subject, a communicating branch between an anterior ethmoidal nerve and a retro-orbital branch of an SPG, a communicating branch between a posterior ethmoidal nerve and a retro-orbital branch of an SPG of the subject, a greater palatine nerve of the subject, a lesser palatine nerve of the subject, a sphenopalatine nerve of the subject, a communicating branch between a maxillary nerve and an SPG of the subject, a nasopalatine nerve of the subject, a posterior nasal nerve of the subject, an infraorbital nerve of the subject, an otic ganglion of the subject, an afferent fiber going into the otic ganglion of the subject, an efferent fiber going out of the otic ganglion of the subject, a vidian nerve of the subject, a greater superficial petrosal nerve of the subject, a lesser deep petrosal nerve of the subject, a cranial nerve of the subject, a nerve to a bladder of the subject, a pudendal nerve of the subject, a nerve of an upper limb of the subject, and a nerve of a lower limb of the subject, and

wherein the shunt is adapted to be electrically coupled between the conductive

elements in contact with the tissue of the structure.

29. Apparatus according to any one of claims 21-28, wherein the tissue includes tissue in a head of the subject and the conductive elements are in contact with the tissue in the head, and wherein the shunt is adapted to be electrically coupled between the conductive elements in contact with the tissue of the head.

30. Apparatus according to claim 29, wherein the tissue includes brain tissue of the subject and the conductive elements are in contact with the brain tissue, and wherein the shunt is adapted to be electrically coupled between the conductive elements in contact with the brain tissue.

31. Apparatus according to any one of claims 21-28, wherein the source of RF energy includes a diagnostic imaging modality, and wherein the shunt is adapted to be in the first state when the subject is exposed to the imaging modality, and to be in the second state when the subject is not exposed to the imaging modality.

32. Apparatus according to claim 31, wherein the imaging modality includes magnetic resonance imaging (MRI), and wherein the shunt is adapted to be in the first state when the subject is exposed to the MRI, and to be in the second state when the subject is not exposed to the MRI.

33. Apparatus according to claim 32, wherein the shunt comprises an impeding element, adapted to

provide the first impedance when the impeding element is exposed to RF energy with a frequency greater than a threshold value no greater than the lowest frequency of RF energy generated by an MRI device generating the RF energy, and

provide the second impedance when the impeding element is not exposed to RF energy with a frequency greater than the threshold value.

34. Apparatus according to claim 33, wherein the threshold value is 5 MHz, and wherein the impeding element is adapted to provide the first impedance when the impeding element is exposed to RF energy with a frequency greater than 5 MHz.

35. Apparatus according to any one of claims 21-28, wherein the shunt comprises:

a impeding element, adapted to provide the first impedance when the shunt is in the first state; and

a switch, adapted to provide the second impedance by providing an open circuit between the conductive elements when the shunt is in the second state.

36. Apparatus according to claim 35, wherein the impeding element comprises at least one resistor, adapted to provide at least a portion of the first impedance.

37. Apparatus according to claim 35, wherein the impeding element comprises at least one capacitor, adapted to provide at least a portion of the first impedance.

38. Apparatus according to claim 35, wherein the impeding element comprises resistive material, adapted to provide at least a portion of the first impedance.

39. Apparatus according to claim 35, wherein the impeding element is adapted to have a surface area greater than a surface area of the conductive elements.

40. Apparatus according to claim 35, wherein the switch is adapted to provide the open circuit unless the switch receives an override signal to provide a closed circuit.

41. Apparatus according to claim 35, comprising an external controller, adapted to remotely operate the switch, and wherein the switch is adapted to be remotely operated by the external controller.

42. Apparatus according to claim 41, wherein the switch comprises an infrared-sensitive optical switch, and wherein the external control is adapted to remotely operate the infrared-sensitive optical switch.

43. Apparatus according to claim 41, wherein the switch comprises a radiofrequency-operated switch, and wherein the external control is adapted to remotely operate the radiofrequency-operated switch.

44. Apparatus comprising a medical device comprising:

two or more conductive elements, adapted to be implanted in a subject and brought in contact with tissue of the subject; and

a shunt, electrically coupled between the conductive elements, the shunt adapted to be in a first state when the subject is exposed to a source of radiofrequency (RF) energy, and adapted to be in a second state when the subject is not exposed to the RF energy, the shunt being characterized such that in the first state the shunt has a first impedance, and in the second state the shunt has a second impedance at least two times greater than the first impedance.

45. Apparatus according to claim 44, wherein the medical device comprises a control unit, adapted to operate the medical device.

46. Apparatus according to claim 44, wherein the conductive elements comprise electrodes.

47. Apparatus according to claim 44, wherein the first impedance is less than 2000 ohms, and wherein the shunt is adapted to have the first impedance when in the first state.

48. Apparatus according to claim 44, wherein the second impedance is at least 4 times greater than the first impedance, and wherein the shunt is adapted to have the second impedance when in the second state.

49. Apparatus according to claim 44, wherein the second impedance is at least 3000 ohms, and wherein the shunt is adapted to have the second impedance when in the second state.

50. Apparatus according to claim 44, wherein the first impedance is at least 50% less than an impedance of the tissue, and wherein the shunt is adapted to have the first impedance when in the first state.

51. Apparatus according to claim 44, wherein the medical device is adapted to be implanted in a body of the subject.

52. Apparatus according to claim 44, wherein the shunt is adapted to be implanted in a body of the subject.

53. Apparatus according to any one of claims 44-52, wherein the conductive elements are adapted to be implanted in a body of the subject.

54. Apparatus according to claim 53, wherein the conductive elements are adapted to be implanted in a heart of the subject.

55. Apparatus according to claim 53, wherein the conductive elements are adapted to be implanted in a structure of the subject selected from the list consisting of: a sphenopalatine ganglion (SPG) of the subject, an anterior ethmoidal nerve of the subject, a posterior ethmoidal nerve of the subject, a communicating branch between an anterior ethmoidal nerve and a retro-orbital branch of an SPG of the subject, a communicating branch between a posterior ethmoidal nerve and a retro-orbital branch of an SPG of the subject, a greater palatine nerve of the subject, a lesser palatine nerve of the subject, a sphenopalatine nerve of the subject, a communicating branch between a maxillary nerve and an SPG of the subject, a nasopalatine nerve of the subject, a posterior nasal nerve of the subject, an infraorbital nerve of the subject, an otic ganglion of the subject, an afferent

fiber going into the otic ganglion of the subject, an efferent fiber going out of the otic ganglion of the subject, a vidian nerve of the subject, a greater superficial petrosal nerve of the subject, a lesser deep petrosal nerve of the subject, a cranial nerve of the subject, a nerve to a bladder of the subject, a pudendal nerve of the subject, a nerve of an upper limb of the subject, and a nerve of a lower limb of the subject.

56. Apparatus according to claim 53, wherein the conductive elements are adapted to be implanted in a head of the subject.

57. Apparatus according to claim 56, wherein the conductive elements are adapted to be implanted in a brain of the subject.

58. Apparatus according to any one of claims 44-52, wherein the source of RF energy includes a diagnostic imaging modality, and wherein the shunt is adapted to be in the first state when the subject is exposed to the imaging modality, and to be in the second state when the subject is not exposed to the imaging modality.

59. Apparatus according to claim 58, wherein the imaging modality includes magnetic resonance imaging (MRI), and wherein the shunt is adapted to be in the first state when the subject is exposed to the MRI, and to be in the second state when the subject is not exposed to the MRI.

60. Apparatus according to claim 59, wherein the shunt comprises an impeding element, adapted to

provide the first impedance when the impeding element is exposed to RF energy with a frequency greater than a threshold value no greater than the lowest frequency of RF energy generated by an MRI device generating the RF energy, and

provide the second impedance when the impeding element is not exposed to RF energy with a frequency greater than the threshold value.

61. Apparatus according to claim 60, wherein the threshold value is 5 MHz, and wherein the impeding element is adapted to provide the first impedance when the impeding element is exposed to RF energy with a frequency greater than 5 MHz.

62. Apparatus according to any one of claims 44-52, wherein the shunt comprises:

a impeding element, adapted to provide the first impedance when the shunt is in the first state; and

a switch, adapted to provide the second impedance by providing an open circuit between the conductive elements when the shunt is in the second state.

63. Apparatus according to claim 62, wherein the impeding element comprises at least one resistor, adapted to provide at least a portion of the first impedance.

64. Apparatus according to claim 62, wherein the impeding element comprises at least one capacitor, adapted to provide at least a portion of the first impedance.

65. Apparatus according to claim 62, wherein the impeding element comprises resistive material, adapted to provide at least a portion of the first impedance.

66. Apparatus according to claim 62, wherein the impeding element is adapted to have a surface area greater than a surface area of the conductive elements.

67. Apparatus according to claim 62, wherein the medical device comprises a control unit, adapted to operate the switch.

68. Apparatus according to claim 62, wherein the switch is adapted to provide the open circuit unless the switch receives an override signal to provide a closed circuit.

69. Apparatus according to claim 62, comprising an external controller, adapted to remotely operate the switch, and wherein the switch is adapted to be remotely operated by the external controller.

70. Apparatus according to claim 69, wherein the switch comprises an infrared-sensitive optical switch, and wherein the external control is adapted to remotely operate the infrared-sensitive optical switch.

71. Apparatus according to claim 69, wherein the switch comprises a radiofrequency-operated switch, and wherein the external control is adapted to remotely operate the radiofrequency-operated switch.